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Waste Storage Tank 8D-4 Radioisotope Inventory Report

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List of Acronyms

CMFT	Concentrator Feed Makeup Tank
CMP	Characterization Management Plan for the Facility Characterization Project (WVDP-403)
FCP	Facility Characterization Project
HLW	High-Level Waste
MFHT	Melter Feed Hold Tank
SBS	Submerged Bed Scrubber
THOREX	Thorium Uranium Extraction Process
VAST	Vitrification Analytical Sample Tracking
WTF	Waste Tank Farm
WVNSCO	West Valley Nuclear Services Company

1.0 Introduction

This report forecasts a conservatively bounded, long-lived radioisotope inventory of Waste Storage Tank 8D-4 (hereafter referred to as Tank 8D-4) for use with performance assessment modeling. Evaluation and characterization activities were conducted in accordance with WVDP-403, "Characterization Management Plan for the Facility Characterization Project" (CMP)[1].

The approach used to evaluate Tank 8D-4 and generate the projected inventory estimate involved the following steps:

- Collection and evaluation of existing/historical data and information for Tank 8D-4.
- Assessment of the available information and determination that the additional information was needed to construct the inventory estimate.
- Collection and evaluation of new dose rate data.
- Calculation of the tank radionuclide inventory using dose-to-curie modeling and scaling factors.

This report has been revised (Revision 2) to incorporate the changes in the Tank 8D-4 inventory based on the latest dose rate surveys collected in December 2003 and January 2004. This inventory report also projects the future inventory of Tank 8D-4 after draining the tank, rinsing the tank once with water, and then potentially draining the tank to the heel.

2.0 Tank 8D-4 Description

Tank 8D-4 is a storage tank in the Waste Tank Farm (WTF), co-located with identical Tank 8D-3 in an underground concrete vault 32 feet (9.75 m) long and 19 feet (5.8 m) wide. The vault is lined to a height of 18 inches with l/8-inch (304 L) stainless steel which forms a pan equipped with an alarmed sump. The tank measures 12 feet in diameter, 15 feet 8 inches high (Figure 1) and has a working volume of 11,500 gallons (43,500 L) and a nominal volume of 14,350 gallons (54,350 L). The tank is constructed of Type 304 L stainless steel with 0.375 inch thick walls and bottom and a 0.313 inch thick top (see Appendix A). The tank has two side-mounted cooling coils and one bottom cooling coil, with a total heat removal capacity of about 175.8 kW. The coils are 1-1/2 inch seamless 304 L stainless steel. The tank is mounted on legs that support the tank 33 inches off the bottom of the vault.

Built as a duplicate to Tank 8D-3, Tank 8D-4 was used in the past to store thorium uranium extraction process (THOREX) waste and is currently used as the receiver tank for collecting liquids and slurries from the Vitrification Facility waste header system[2].

3.0 Historical Record Review

The following reports/records were found to contain background information on Tank 8D-4:

- "High-Level Radioactive Waste Pretreatment at the West Valley Demonstration Project," D. C. Meess, Waste Management ‘96, February 1996.

- "High-Level Waste Storage Area and Vitrification Facility Waste Characterization Report," WVDP-EIS-017

- "Draft Environmental Impact Statement for Completion of the West Valley Demonstration Project and Closure or Long-Term Management of Facilities at the Western New York Nuclear Service Center," DOE/EIS-0226-D, January 1996.

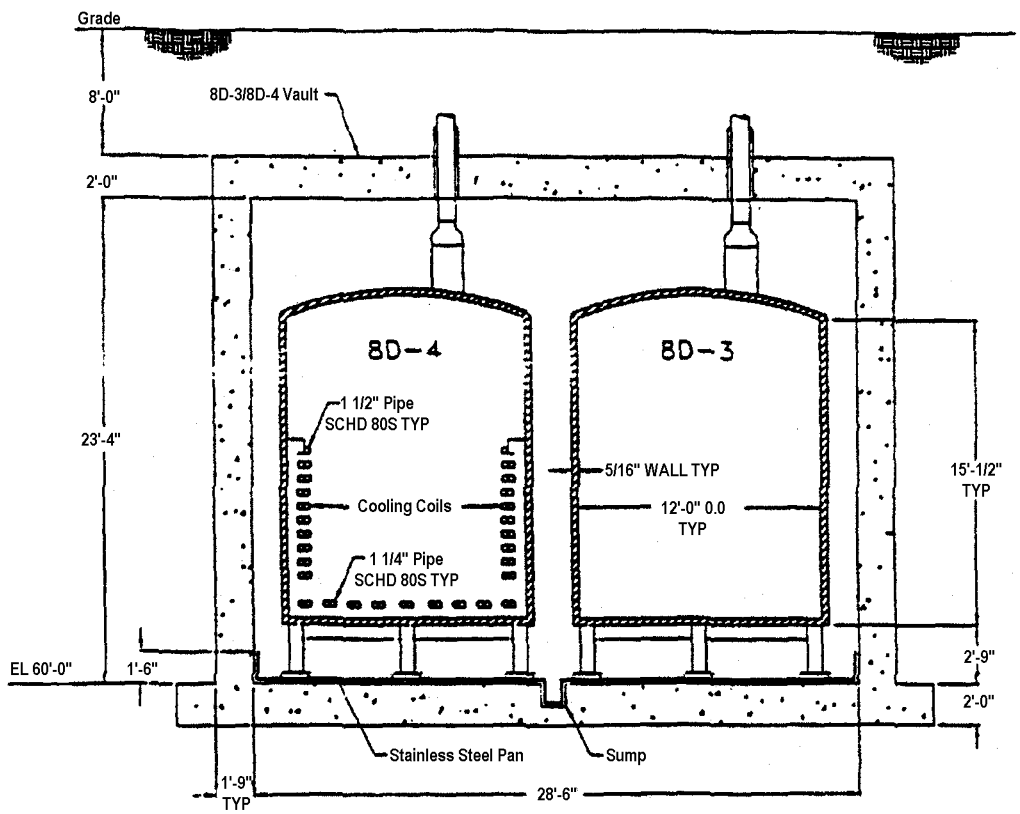

Figure 1

Tanks 8D-3 and 8D-4

3.1 Operating History

From November 13, 1968 through January 19, 1969, Nuclear Fuel Services processed a single core of mixed thorium and uranium fuel[3]. The products from the mixed oxide fuel campaign of thorium-enriched uranium fuel was stored as a nitric acid solution in Tank 8D-4. While awaiting future extraction operations, commercial activities ceased before the final thorium extraction step was completed. In 1980, the Department of Energy declared the nitric acid solution in Tank 8D-4 a waste upon assumption of remediation activities at the site.

This THOREX waste resulted from the processing of approximately 16 metric tons of a thorium-enriched uranium fuel from the Indian Point Nuclear Plant. The initial composition of the fuel was 93.5 percent thorium, in the form of thorium oxide, and approximately 6.5 percent enriched (93 percent) uranium, also in the form of an oxide. Processing of the fuel involved shearing the stainless steel fuel tubes into short lengths and dissolving the fuel in concentrated nitric acid in the presence of approximately 0.04 to 0.05 molar fluoride and 0.1 molar boric acid[4].

The total volume of the waste was approximately 13,000 gallons[5], at a calculated specific gravity of 1.656. The waste was maintained between 40 to 50EC with three cooling units. The THOREX waste was stored in an unneutralized acid form in the stainless steel Tank 8D-4 to prevent precipitation of the thorium. The waste was believed to predominantly consist of a single phase with some sludge or precipitates present[5]. The operating history of Tank 8D-4 is graphically shown in Figure 2[6].

In January 1995, the Tank 8D-4 THOREX waste was transferred to Tank 8D-2 for treatment and subsequent vitrification. It is estimated that in 1995 less than 3 percent of the original THOREX inventory remained in the tank, and in 1996, further transfers and dilution had reduced the THOREX content to only trace amounts which is documented in Reference 7. The THOREX waste dilution model is shown in Table 1. It should be noted that the contents of Tank 8D-4 were recirculated and mixed well before being transferred to Tank 8D-2. This waste was soluble in an acid matrix as it was maintained until transferred[25, 26].

Since that time, Tank 8D-4 has received liquids from several sources within the Vitrification Facility via the waste header which included the Submerged Bed Scrubber (SBS) liquids, Melter Feed Hold Tank (MFHT) seal pot liquid, canister decontamination station liquids, and liquids from the Vitrification sumps. Although these liquid additions are assumed to have further diluted the THOREX residue, they may also have contributed solids and radionuclides to Tank 8D-4. A review of daily operating reports from the Vitrification Facility and Tank Farm areas was conducted. Approximately 13,000 gallons of liquid from the Vitrification Facility was transferred to Tank 8D-4[8]. The composition of the residual wastes in Tank 8D-4 may be similar to high-level waste (HLW).

Beginning in early 2001, flushing of the HLW systems including Tank 8D-4 was initiated to support melter shutdown. Flushing was conducted in accordance with the WVNS-IRP-005, “HLW Processing Systems Flushing Operations Run Plan," and consisted of dilute 1 molar nitric acid and water flushes from February 2001 to March 2002[9]. As recently as July 2002, water flushing of Tank 8D-4 was performed. About 10,000 gallons of water and 5,000 gallons of nitric acid have been used. Table 2 shows the flushing history of Tank 8D-4.

On January 30, 2004, Tank 8D-4 received 5,524 liters of liquid from the CFMT[10]. A CFMT liquid sample was collected on July 24, 2003 and analyzed for radionuclides[11]. Table G of Appendix B summarizes the radionuclide inventory transferred from the CFMT to Tank 8D-4.

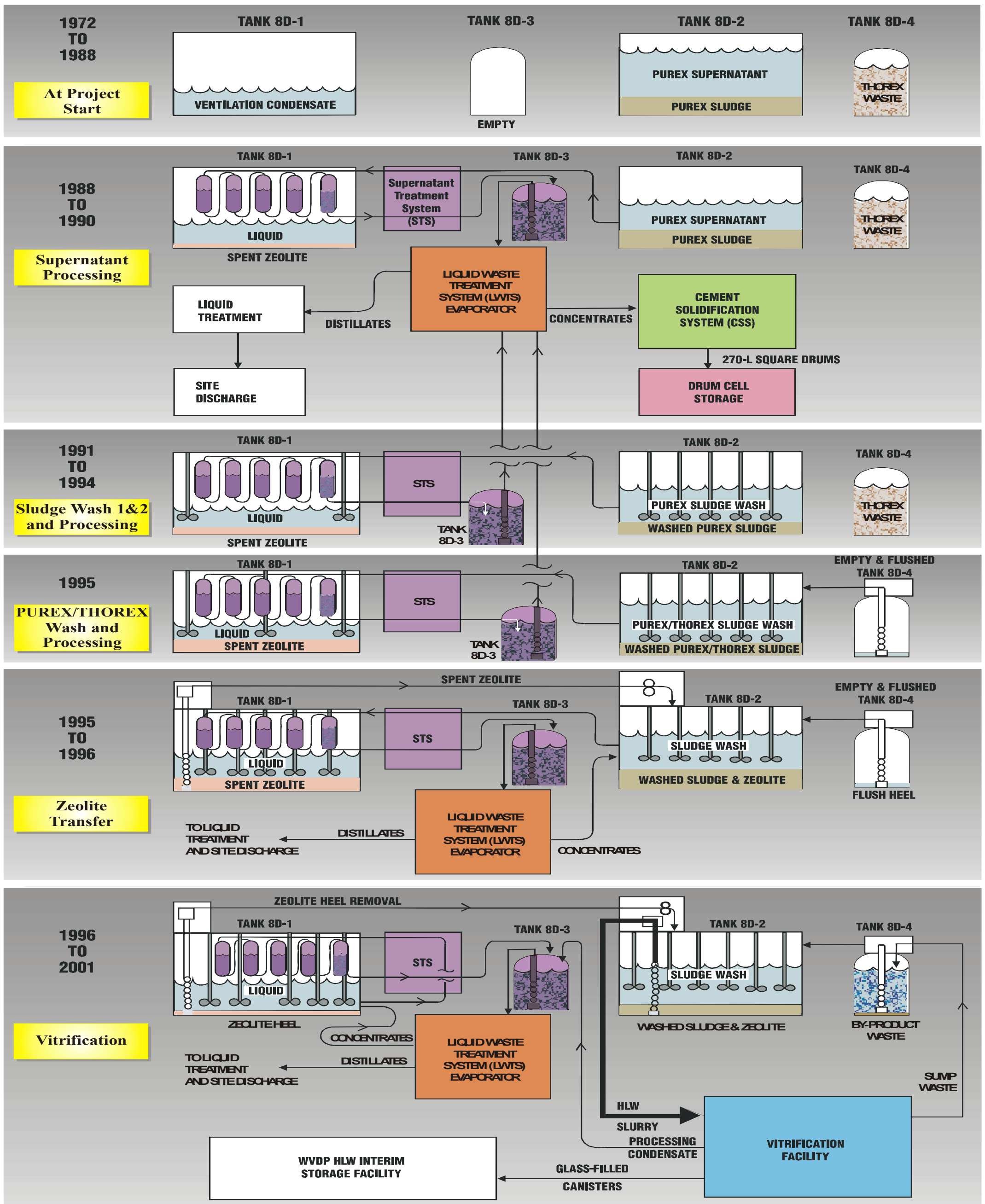

Figure 2

HLW Pretreatment and Subsequent Vitrification Processing

Table 1

Dilution Model of Tank 8D-4 THOREX Waste[7]

Date	Tank 8D-4 Initial Volume (Gallons)	Tank 8D-4 Final Volume (Gallons)	Liquid Volume Transferred (Gallons)	Volume Water Added (Gallons)	THOREX Remaining in Tank 8D-4 (Gallons)	THOREX Remaining in Tank 8D-4 (% of Initial)
1/9/95		13,356	0	0	13,356	100
1/11/95	13,356	8,303	5,053	3,498	8,303	62.17
1/12/95	11,801	1,794	10,007	6,623	1,262	9.45
1/20/95	8,417	2,028	6,389	3,168	304	2.28
4/9/96	5,196	3,330	1,866	1,929	195	1.46
4/10/96	5,259	3,346	1,913	3,215	124	0.93
6/6/96	6,561	3,346	3,215	3,611	63	0.47
6/21/96	6,957	2,530	4,427	6,006	23	0.17
7/19/96	8,536	5,464	3,072	136	15	0.11
7/22/96	5,600	2,272	3,328	4,558	6	0.045
8/12/96	6,830	3,620	3,210	942	3	0.024
8/15/96	4,562	1,693	2,869	6,325	1	0.009
9/9/96	8,018	1,680	6,338	5,559	0.2	0.0018
10/7/96	7,239	1,697	5,542	4,108	0.1	0.0004
11/8/96	5,805	2,177	3,628	3,696	0.01	0.0002
12/13/96	5,873	2,185	3,688	2,869	0.01	0.0001

Table 2

Tank 8D-4 Flushing History

Date	Work Document	Flushing Process	Gallons		8D-4 % Full	
			In	Out	Start	End
2/5/01	0001293[12]	Water addition to 8D-4	888 water		58%	64.8%
8/6/01	SOP 63-36[13]	SBS to 8D-4	806 SBS		64.8%	70.4%
8/8/01	SOP 55-14[14]	8D-4 to 8D-2		5,108	70.4%	33%
8/20/01	SOP 55-14	8D-4 to 8D-2		2,896	33%	11.8%
10/11/01	0100249[15]	Water addition to 8D-4	902 water		11.9%	18.8%
11/4/01	0100069[16]	Acid addition to 8D-4	3,155 acid		18.8%	42%
11/5/01	0100069	Acid addition to 8D-4	1,229 acid		42%	50.9%
11/9/01 thru 1/9/02	0100069	Water addition to 8D-4	1,031 water		50.9%	58.9%
11/6/01 to 11/28/01	0100069	Acid soak of 8D-4			58.9%	58.9%
Acid Flush #1						
1/10/02	0101671	Acid flush 8D-4 to CFMT		3,595 acid	58.9%	31.2%
1/14/02	0101671	Acid flush 8D-4 to CFMT		2,371 acid	31.2%	12.4%
1/19/02	0101671	Water addition to 8D-4	6,300 water		12.4%	58.5%
1/19/02	0101671	Water flush 8D-4 to CFMT		3,739 water	58.5%	30.3%
1/21/02	0101671	Water flush 8D-4 to CFMT		2,283 water	30.3%	12.2%
1/25/02	SOP 55-20[17]	Water flush 8D-4 to CFMT	150 water		12.2%	13.2%
Acid Flush #2						
3/18/02	0101671	Transfer of acid flush #2 to 8D-4	615 acid		13.7%	18.1%
3/19/02	61950[18]	Acid flush of SMS and 8Q Pits 8D-4 to CFMT (Transfer #1)		624 acid	18.1%	13%
3/19/02	61950	Add water to 8D-4	700 water		13%	18%
3/20/02	61950	Water flush of SMS and 8Q Pits 8D-4 to CFMT (Transfer #2)		816 water	18%	13.4%
6/5/02	SOP 63-36	Transferred SBS to 8D-4	1,871		13.4%	23.8%

4.0 Technical Approach/Data Gathering

The technical approach to quantify the radiological inventory for the HLW Storage Tank 8D-4 is based on process knowledge, existing verifiable data, samples, and newly collected dose rate surveys[19]. Dose-to-curie modeling and scaling factors were used to convert dose rate measurements to curies of key radioisotopes to generate a conservatively bounded curie estimate.

In January 2004, CFMT liquid was transferred to Tank 8D-4. Revision 2 of the estimated curie inventory in Tank 8D-4 incorporates this transfer. Additionally, estimated future inventories are calculated and projected based on anticipated post-September 30, 2004 work activities including the draining of Tank 8D-4, rinsing the tank once with water, and then draining the tank to the heel. The technical approach and assumptions associated with the post-September 30, 2004 estimates are summarized as follows.

The estimated curie estimate for Tank 8D-4 after the CFMT transfer is the sum of the following:

- The inventory of Tank 8D-4 based on the December 2003 and January 2004 dose rate surveys that were conducted before the CFMT liquid transfer to Tank 8D-4.

- The inventory of the CFMT liquid that was transferred to Tank 8D-4 based on sample analysis data and the associated transfer volume.

The projected, post-September 30, 2004 estimated curie estimates for Tank 8D-4 will assume that the tank will be drained to a remaining heel of 1,800 gallons. After draining, it is assumed that Tank 8D-4 will be rinsed one time by filling the tank with approximately 12,000 gallons of water then draining it again down to a diluted heel of 1,800 gallons.

4.1 Field Measurements and Physical Sampling

The general area gamma dose rate field measurements collected per Work Order 69053[19] were used as input to the MicroShield™ computer model to quantify Cs-137 as the scaling radionuclide. Through the use of scaling ratios for the specific long-lived radionuclides to the scaling radionuclide Cs-137, the Tank 8D-4 source term was calculated. Scaling ratios were determined from a review of historic data, including THOREX waste, Vitrification Batch 10, and SBS liquid radionuclide profiles, and from the CFMT liquid samples collected before and after transfers from Tank 8D-4. A comparison of the scaling factors for Tank 8D-4 flush samples collected from the CFMT, decayed scaling factors for THOREX waste, and Vitrification Batch 10 profiles was made for each radioisotope of concern.

A comparison of THOREX scaling factors to Batch 10 HLW scaling factors indicates that THOREX is more conservative for C-14, Tc-99, I-129, U-232, and U-235. However, as demonstrated in the dilution model (Table 2), Tank 8D-4 was repeatedly flushed with water and acid prior to the vitrification system shutdown. The solubility of many of the radionuclides, such as Tc-99, would substantiate that they are no longer present in the concentrations of the original THOREX waste. Table 3 summarizes the scaling factors for Tank 8D-4 based on Batch 10 and Tank 8D-4 flushing solutions.

To conservatively bound the Tank 8D-4 radioisotopic inventory, scaling factors from Batch 10 and the Tank 8D-4 flush profile are compared. As shown in Table 3, most conservative value of scaling factor for each radioisotope of concern was selected for radionuclide inventory estimate.

4.2 Visual Techniques

No visual observations were employed in Tank 8D-4.

4.3 Sample Data Assessment

The Batch 10 and THOREX scaling factors shown in Table 3 were derived from the radionuclide distributions shown in Tables A and B of Appendix B. The Tank 8D-4 flush profile scaling factors, also shown in Table 3, were developed from samples collected from Tank 8D-4 liquids transferred to the CFMT during Tank 8D-4 flushing operations in January 2002.

Using the data provided in Tables C and D of Appendix B, the curies transferred from Tank 8D-4 to the CFMT (Flush #1) can be calculated as shown in Table E of Appendix B. The Tank 8D-4 flush profile scaling factors shown in Table 3 are based on the curies transferred as part of Tank 8D-4 Flush #1 between January 10, 2002 and January 25, 2002[20].

As a check of the Tank 8D-4 flush profile scaling factors, pre- and post-Tank 8D-4 Flush #2 liquid samples were collected from the CFMT in March 2002. For this check, only a limited set of radionuclides were analyzed which are shown in Table F of Appendix B. The curies transferred from Tank 8D-4 to the CFMT as part of Tank 8D-4 Flush #2 were calculated and are shown in Table 4. Finally, the scaling factors from Flush #2 are compared to Flush #1 scaling factors in Table 5. In general, there are no significant differences.

SBS liquids transferred to Tank 8D-4 in 2002 have also been evaluated to determine the effect on the Tank 8D-4 radiological inventory. Table 6 shows SBS liquid analytical results for samples taken in 2001 and 2002[22]. SBS liquid scaling factors derived from the average of these results are shown in Table 7 are bounded by the scaling factors reported in Table 3.

The radionuclide inventory of the CFMT was calculated based on the analysis of CFMT sample taken on July 7, 2003[11]. Plant Systems Operations Daily Reports[10] of January 29, 2004 and January 30, 2004 provided the total volume of liquid transferred from the CFMT to Tank 8D-4. The radionuclide inventory of Tank 8D-4 before the CFMT transfer was estimated based on dose rate surveys and MicroShield™ modeling as discussed in Section 7.

5.0 Sampling Procedure

Additional surveys of Tank 8D-4, utilizing a general area gamma radiation detector, were identified as being required to support the development of a conservatively bounded curie estimate for the estimation of radionuclide inventory in Tank 8D-4. Surveys were needed to provide updated and more location-specific data and/or to determine if identified areas are potential significant sources of contamination. Work Document WTF-69053[19] was written to install a general area gamma radiation detector and to obtain radiation surveys of the Tank 8D-4 vault at various elevations and with different liquid levels in the tank and describes the procedures used for measuring radiation probe readings.

Utilizing the radiation detector installed at the Tank 8D-4 vault for the above mentioned work order, additional survey readings were taken and recorded on Radiation and Contamination Survey Report 123029 dated December 31, 2003[23]. Surveys were needed to update the inventory estimate in Tank 8D-4 before the CFMT liquid was transferred to Tank 8D-4. Tables G and Table H of Appendix B provide the radionuclide inventory of the CFMT before and after liquid transfer and total curie transfer to Tank 8D-4.

6.0 Sampling Results and Data Validation

In July 2002, results of the survey were recorded in Work Order WTF-69053[19]. The July 2002 survey was performed utilizing a general area gamma radiation detector (Ludlum Model 133-7, Serial Number PR 102741) and a survey rate meter (Ludlum Model 2350, Serial Number 126208). Survey readings were taken and verified in accordance with West Valley Nuclear Services Company (WVNSCO) policies and procedures as identified in the CMP (e.g., WVDP-010, "WVDP Radiological Controls Manual").

Table 3

Isotopic Scaling Factors as of September 30, 2004
(Scaled to Cs-137)

Project Isotope	Batch 10 Profile Scaling Factor Decayed[21]*	8D-4 Flush Profile Scaling Factor**	8D-4 Flush Profile Scaling Factor*		Selected Scaling Factor*
			As of January 25, 2002	As of September 30, 2004	
C-14	2.03e-07	2.33e-07	2.48e-07	2.48e-07	2.48e-07
Tc-99	3.51e-05	4.02e-05	4.28e-05	4.28e-05	4.28e-05
I-129	1.62e-10	1.86e-10	1.98e-10	1.98e-10	1.98e-10
U-232	No Data	4.29e-07	4.79e-07	4.45e-07	4.45e-07
U-233	1.49e-06	1.21e-07	1.29e-07	1.29e-07	1.49e-06
U-234	5.73e-07	1.14e-04	1.21e-04	1.21e-04	1.21e-04
U-235	1.58e-08	1.13e-09	1.20e-09	1.20e-09	1.58e-08
Np-237	8.30e-06	2.63e-07	2.80e-07	2.80e-07	8.30e-06
U-238	1.41e-07	3.37e-09	3.59e-09	3.59e-09	1.41e-07
Pu-238	1.55e-03	1.06e-04	1.11e-04	1.11e-04	1.55e-03
Pu-239	4.52e-04	1.44e-05	1.53e-05	1.53e-05	4.52e-04
Pu-240	3.21e-04	1.10e-05	1.17e-05	1.17e-05	3.21e-04
Pu-241	9.96e-02	3.45e-04	3.22e-04	3.22e-04	9.96e-03
Am-241	1.33e-02	4.99e-04	5.30e-04	5.30e-04	1.33e-02
Cm-243	8.96e-05	3.37e-06	3.36e-06	3.36e-06	8.96e-05
Cm-244	2.10e-03	8.79e-05	8.44e-05	8.44e-05	2.10e-03
Cs-137	1.00e+00	1.00e+00	1.00e+00	1.00e+00	1.00e+00
Sr-90	9.54e-01	3.94e-02	3.93e-02	3.93e-02	9.54e-01

* Decayed to September 30, 2004.

** As of January 25, 2002.

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Table 4

Pre- and Post-Tank 8D-4 Flush #2 CFMT Inventory

Radionuclide	Pre-Flush #2 CFMT Inventory (Ci)	Post-Flush #2 CFMT Inventory (Ci)	Curies Transferred from Tank 8D-4
Gross Alpha	18	23	5
Gross Beta	56,133	59,543	3,410
Sr-90	882	1,216	334
Am-241	21	12	(9)
Cs-137	47,811	48,886	1,075

Table 5

Flush #1 and Flush #2 Scaling Factor Comparison

Radionuclide	Tank 8D-4 Flush #1		Tank 8D-4 Flush #2	
	Curies Transferred from Tank 8D-4	Scaling Factor to Cs-137	Curies Transferred from Tank 8D-4	Scaling factor to Cs-137
Gross Alpha	10	8e-04	5	5e-03
Gross Beta	14,210	1e+00	3,410	3e+00
Sr-90	533	4e-02	334	3e-01
Am-241	7	5e-04	(9)	0e+00
Cs-137	13,144	1e+00	1,075	1e+00

Table 6

SBS Liquid Sample Results

Radionuclide	VAST 00-1048 May 30, 2000 (μCi/g)	VAST 00-2153 October 6, 2000 (μCi/g)	VAST 00-2155 October 12, 2000 (μCi/g)
Tc-99	1.66e-01	2.91e-01	4.86e-02
U-232	1.30e-04	3.03e-04	1.80e-05
U-233	1.07e-04	8.80e-05	7.45e-06
U-234	5.20e-05	4.20e-05	3.55e-06
U-235	8.50e-06	2.75e-06	3.25e-06
Np-237	9.47e-04	5.99e-04	1.06e-04
U-238	2.80e-05	8.90e-06	1.10e-05
Pu-238	1.36e-01	8.26e-02	1.47e-02
Pu-239	3.46e-02	2.12e-02	4.38e-03
Pu-240	2.65e-02	1.62e-02	3.35e-03
Am-241	1.19e+00	7.15e-01	1.00e-01
Cs-137	7.69e+03	8.22e+03	1.34e+03
Sr-90	9.77e+01	2.43e+00	6.33e+00

Table 7

Average SBS Liquid Scaling Factors

Radionuclide	VAST Average (μCi/g)	Ratio to Cesium
Tc-99	1.69e-01	2.93e-05
U-232	1.50e-04	2.61e-08
U-233	6.84e-05	1.19e-08
U-234	3.26e-05	5.67e-09
U-235	4.83e-06	8.40e-10
Np-237	5.51e-04	9.58e-08
U-238	1.60e-05	2.78e-09
Pu-238	7.78e-02	1.35e-05
Pu-239	2.01e-02	3.50e-06
Pu-240	1.53e-02	2.66e-06
Am-241	6.68e-01	1.16e-04
Cs-137	5.75e+03	1.00e+00
Sr-90	3.55e+01	6.17e-03

Calibration of the Ludlum 2350 was performed in accordance with WVDP-318, "WVDP Radiological Instrumentation Calibration and Maintenance Program Manual," RC-IOC-1, "Administrative Aspects of Radiological Instrument Calibration and Maintenance," and RC-IOC-46, "Calibration Instructions for the Ludlum 2350 Data Logger." Calibration certification is provided in Work Order WTF-69053(19). The validation report for the surveys is maintained in the Facility Characterization Project (FCP) file.

Survey readings recorded in Radiation and Contamination Survey Report 123029(23) were validated and are maintained in FCP file.

7.0 Data Analysis

Dose-to-curie modeling based on the December 31, 2003 dose rate readings of Tank 8D-4 was conducted using MicroShield™ software. MicroShield™ modeling calculations are provided in Appendix C. As identified in the CMP, the modeling was performed by personnel trained in the use of the MicroShield™ software and the modeling calculations provided in Appendix C have been peer reviewed.

Dose-to-curie modeling inputs include dose rate measurements, an isotopic distribution that can be associated with the contamination in Tank 8D-4, and the configuration/dimensions of the tank. Due to the fact that Tank 8D-3 is co-located with Tank 8D-4 within the same tank vault, the effects of Tank 8D-3 inventory on dose measurements were evaluated earlier(24). It is noted in Reference 24 that there was little change in measured dose rates by any increase in Tank 8D-3 liquid levels since the probe was effectively shielded by the contents in Tank 8D-4. MicroShield™ modeling has considered deposition on internal surface and effect of internal cooling coils. No preferential deposition of specific radionuclide is expected on internal surface. The internal surface contamination or deposition is similar in composition as that of Tank 8D-4 liquid contents.

The modeling was performed assuming a dose rate that was due entirely to Cs-137. While many radionuclides emit gamma radiation during decay, their contribution would not significantly change the dose rate due to lower energies or low abundance. Per the CMP, the Tank 8D-4 MicroShield™ modeling results have been decayed to the reference date of September 30, 2004.

As documented in Radiation and Contamination Survey Report 123029(23), dose rate measurements were obtained at a known distance from Tank 8D-4 and at different elevations. Using this information and the conservatively selected radionuclide scaling factors given in Table 3, Tank 8D-4 was modeled with the resultant conservatively bounded curie estimates provided in Table 8. Table 8 also provides the curie estimates for Tank 8D-4 after the January 30, 2004 CFMT transfer and for the following potential future (post-September 30, 2004) scenarios: after draining the tank down to its 1,800 gallon heel, then after rinsing the tank with approximately 12,000 gallons of water, then after draining it again down to a diluted heel of 1,800 gallons.

8.0 Data Limitations

The curie estimates identified above were generated to meet the objectives of the Facility Characterization Project and to facilitate their potential use in the site's performance assessment model. The technical approach, model inputs and assumptions, and the conclusion that the generated curie estimates are conservatively bounding, has been reviewed and validated/approved by the project's Technical Review and Approval Panel (Appendix D) pursuant to the requirements of the CMP.

It is assumed that the Tank 8D-4 contents will be drained and rinsed at lest one time by filling Tank 8D-4 with water and drained again. Approximately 1,800 gallons of diluted heel will remain in Tank 8D-4. Estimated radionuclide inventory as of September 2004 for each case is calculated based on these projected activities.

Table 8

Conservative Curie Estimates for Tank 8D-4(2)

Project Isotope	Tank 8D-4 Inventory After CFMT Transfer	Projected Tank 8D-4 Inventory After Drain(1) (1,800 Gallons of Heel)	Projected Tank 8D-4 Inventory After Rinse and Drain(1) (1,800 Gallons of Heel)
C-14	3.81e-03	1.70e-03	2.24e-04
Tc-99	1.86e+00	8.29e-01	1.09e-01
I-129	3.04e-06	1.36e-06	1.79e-07
U-232	2.20e-02	9.84e-03	1.30e-03
U-233	1.73e-02	7.72e-03	1.02e-03
U-234	7.52e-01	3.36e-01	4.43e-02
U-235	4.27e-04	1.91e-04	2.52e-05
Np-237	5.45e-02	2.43e-02	3.21e-03
U-238	1.75e-03	7.82e-04	1.03e-04
Pu-238	9.92e+00	4.43e+00	5.84e-01
Pu-239	2.89e+00	1.29e+00	1.70e-01
Pu-240	2.06e+00	9.20e-01	1.21e-01
Pu-241	6.36e+01	2.84e+01	3.74e+00
Am-241	8.38e+01	3.74e+01	4.93e+00
Cm-243	5.62e-01	2.51e-01	3.31e-02
Cm-244	1.32e+01	5.89e+00	7.77e-01
Cs-137	1.53e+04	6.86e+03	9.04e+02
Sr-90	5.91e+03	2.64e+03	3.48e+02

(1) These activities have the potential to occur after September 30, 2004.

(2) Estimates have been aged to a reference date of September 30, 2004.

Prepared By: ______________________
V. K. Sharma

Peer Reviewed By: ______________________
J. M. Fazio

9.0 References

1. WVDP-403, "Characterization Management Plan for the Facility Characterization Project," Revision 0, dated May 13, 2002.

2. WVDP-EIS-017, "High Level Waste Storage Area and Vitrification Facility Waste Characterization Report," Revision 1, dated September 28, 1995.

3. WVNSCO Technical Paper, "High-Level Waste Radioactive Waste Pretreatment at the west Valley Demonstration Project," D. C. Meess, Waste Management '96, February 1996.

4. WVNSCO Topical Report DOE/NE/44139-83, "Integrated Radwaste Treatment System Final Report," October 1997.

5. WVDP-152, "Resource Conservation and Recovery Act Closure Plan for the High Level Waste Process Tanks and Treatment Facility High Level Waste Tanks 8D-3 and 8D-4 and Supernatant Treatment System," Revision 0, dated June 12, 1992.

6. Hamel, W. F. , McMahon, C. L., Meess, D. C., "Waste Removal from the West Valley Demonstration Project High-Level Radioactive Waste Storage Tanks," Waste Management 2000, February 2000.

7. WVNSCO Internal Informal Memorandum, S. Kumar to D. C. Meess, "HLW Tank 8D-4 - THOREX Residue," dated November 16, 1999.

8. WVNSCO Daily Operation Reports, High-Level Waste Tank Farm and Vitrification Facility, May 1996 through July 2002.

9. WVNS-IRP-005, "HLW Processing Systems Flushing Operations Run Plan," April 29, 2002.

10. Plant Systems Operations Daily Operation Reports dated January 29, 2004 and January 30, 2004.

11. Vitrification Analytical Sample Tracking (VAST) Report 03-1155.

12. WVNSCO Work Order 0001293, "Conduct Demineralized Water Flush of Waste Header North and South Branches," July 27, 2000.

13. WVNSCO Standard Operating Procedure (SOP) 63-36, "Off-Gas and Vessel Ventilation System Operation," June 22, 2000.

14. WVNSCO Standard Operating Procedure (SOP) 55-14, "Waste Transfer for Tank 8D-4 to Tank 8D-2," June 15, 2003.

15. WVNSCO Work Order 0100249, "Conduct Water Flush of Waste Header South Branches," February 23, 2001.

16. WVNSCO Work Order 0100069, "Acid Flush Waste Header," February 5, 2001.

17. WVNSCO Standard Operating Procedure (SOP) 55-20, "Tank 8D-4 Transfer to CFMT," February 27, 2002.

18. WVNSCO Work Order 61950, "Flush Sludge Jumpers/Manifolds and SMS Transfer Lines," March 4, 2002.

19. WVNSCO Work Order 69053, "Tank Internal Rad Probe Readings of 8D-4 Vault Elevations with Data Logger," July 11, 2002.

20. WVNSCO Work Order 0101671, "Flush Zeolite Jumpers/Manifolds and SMS Lines," January 9, 2002.

21. RIR-403-021, "Extraction Cell 3 Radioisotope Inventory Report," August 29, 2003.

22. VAST Report 00-1048, 00-2153, and 00-2155.

23. Radiation and Contamination Survey Report 123029, "Dose Rate at Tank 8D-4 Vault," December 31, 2003.

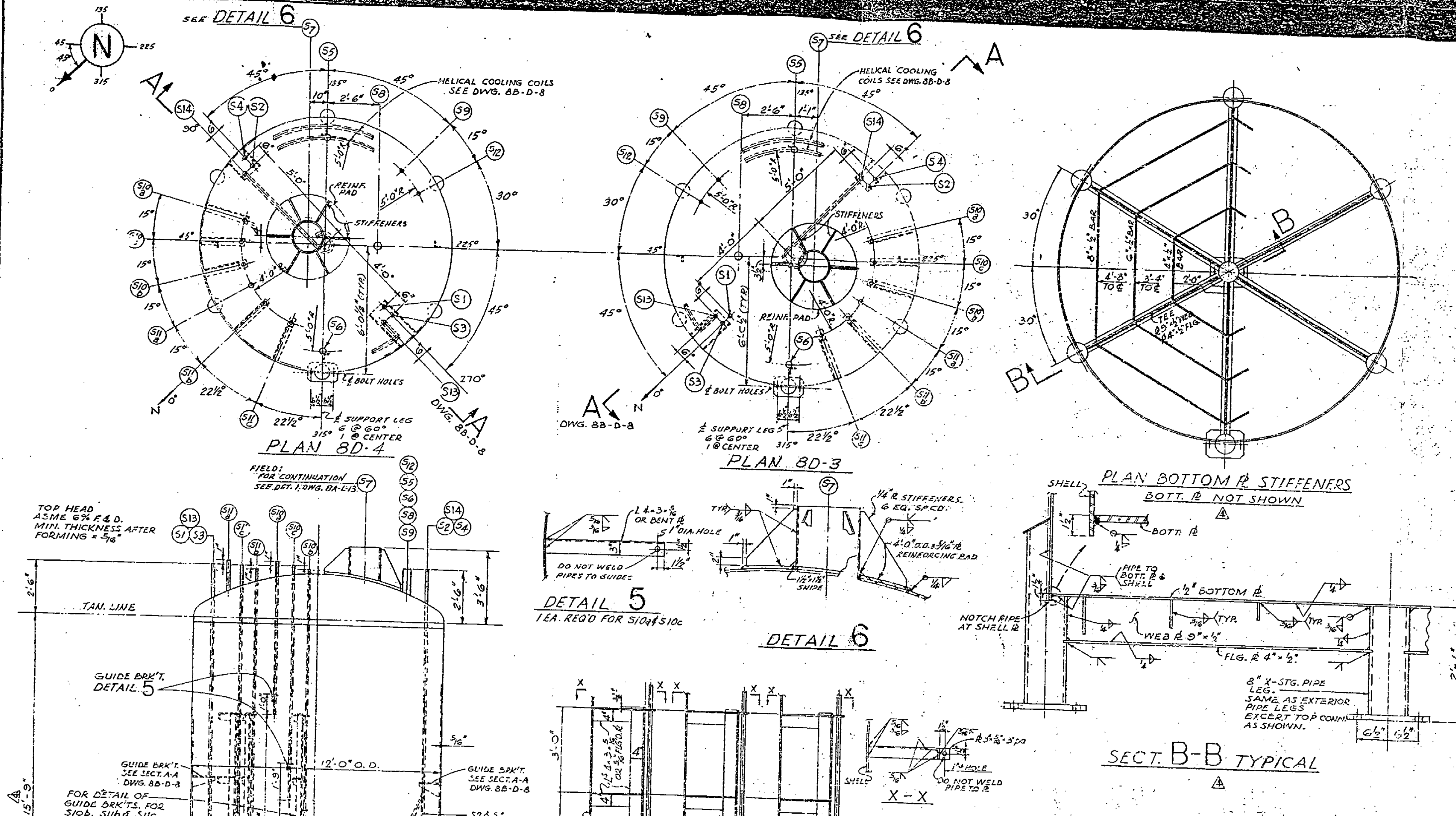
24. WVNSCO Internal Memorandum EB:2003:0019, R. Brooks to L. E. Rowell, "Updated Tank 8D-4 Cesium 137 Concentration," dated May 8, 2003.

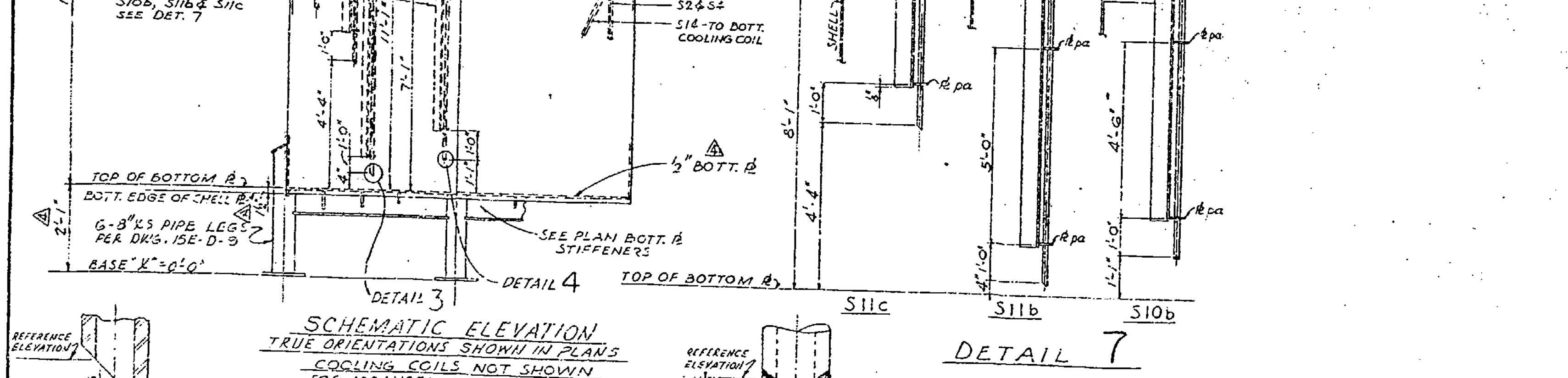
25. WVNS-SD-055, "Sludge Mobilization System HLW Transfer System," Revision 3, dated August 17, 1998.

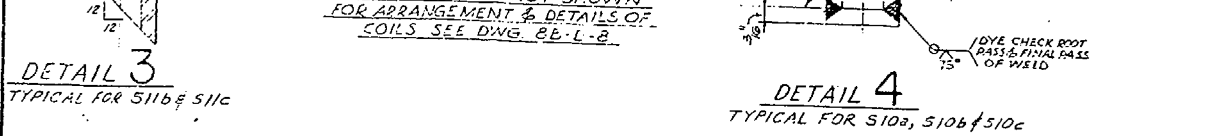
26. WVNSCO Letter Report LW:83:0011, "Analysis of the Liquid Acid Waste from Tank 8D-4 at West Valley Nuclear Services," Z. Lawrence Kardos, Westinghouse Electric Corporation Advanced Energy System Division, Analytical Laboratories, Waltz Mill Site, September 9, 1983.

Appendix A

Tank 8D-4 Design Drawing 8B-D-4







NOTES FOR REVISION ⚠4
DELETED: BOTTOM F.& D. HEAD.
ADDED: FLAT PLATE HEAD W/STIFFENERS & PIPE LEG AT CENTER. PLAN OF BOTTOM STIFFENERS & SECT. B-B SHOWN.
REVISED: DIM. FROM TOP HD. TAN. LINE TO TOP OF BOTTOM ℞ & FROM ℞ TO BOTT. OF PIPE LEGS.

NOTES

1. DESIGN DATA:
   INTERNAL PRESSURE = 6 PSIG
   TEMPERATURE (MAX. STORAGE) = 131°F
   TEMPERATURE (STEAM OUT) = 240°F
   CORROSION ALLOWANCE = 0.07"
2. FABRICATION TO BE IN ACCORDANCE WITH ASME CODE SECTION VIII AS APPLICABLE, AND SPEC. 4413-C-2. CODE STAMP NOT REQ'D.
3. MATERIAL:
   SHELL & HEADS ~ PLATE A-240 TP-304L
   INTERNAL ATTACHMENTS ~ A-240 TP-304L
   EXTERNAL SUPPORTS ~ TP-304 OR 304L
   PIPE ~ A-312 TP-304L SEAMLESS
   ADDITIONAL MATERIAL TESTING PER SPEC. 4413-C-2, PAR. 3.2 IS REQUIRED.
4. INSPECTION AND TESTING:
   (a) VESSEL TO BE 100% X-RAYED PER SPEC. 4413-C-2.
   (b) VESSEL TO BE HELIUM LEAK TESTED IN SHOP PER SPEC. 4413-C-2.
   (c) VESSEL TO BE HYDROSTATICALLY TESTED IN SHOP TO 30 PSIG AT TOP.
   (d) COILS TO BE TESTED PER SPEC. 4413-C-2, PAR. 5.2.
   (e) ALL BUTT WELDS IN COILS TO BE 100% X-RAYED.
5. CONNECTIONS:
   (a) SEE DWG. 15E-D-5 FOR DET. OF STUB NOZZLES.
   (b) EXCEPT AS OTHERWISE NOTED, PIPE WALL THICKNESS SHALL CONFORM TO THE FOLLOWING:
   1" & SMALLER = SCH. 160S
   1¼", 1½" & 2" = SCH. 80S
   3" THRU 6" = SCH. 40S
   (c) SEAMLESS LONG RADIUS WELDING FITTINGS SHALL BE USED UNLESS OTHERWISE NOTED.
   (d) CONNECTION TO VESSEL TO BE PER CODE FIG. UW-16.1 (c).
6. THE USE OF BACK-UP STRIPS WHICH REMAIN IN PLACE IS NOT ACCEPTABLE. (SEE NOTE 9.)
7. SHOP PAINT: NONE
8. NAME PLATE: NONE
   PROVIDE REMOVABLE METAL IDENTIFICATION TAG FOR SHIPPING. NO ATTACHMENTS OTHER THAN THOSE SHOWN SHALL BE WELDED TO VESSEL.
9. FOR SEAMS WHICH CANNOT BE WELDED FROM BOTH SIDES, ROOT PASSES TO BE MADE BY TUNGSTEN INERT GAS PROCESS.

REFERENCE DRAWINGS

STUB NOZZLE DETAILS — 15E-D-5
PIPE LEG SUPPORTS — 15E-D-9
COOLING COIL DETAILS — 8B-D-8

NOTES FOR REVISION ⚠3
COOLING COILS REVISED AND REDRAWN, (DELETED ONE FLAT COIL, ADDED 2-HELICAL COOLING COILS, REVISED SIZE AND LOCATION OF BOTTOM COIL).
REVISED LOCATION AND SERVICE FOR S1, S2, S3 & S4.
REVISED GUIDES FOR S10 & S11.
REVISED CORROSION ALLOWANCE (WAS 1/8").
ADDED S13, S14 AND REF. DWG.

NOTES FOR REVISION ⚠1:
REVISED & RENUMBERED CONNECTIONS.
REVISED LAYOUT FOR COOLING COILS.
ADDED ORIENTATIONS & DETAILS.

NOTES FOR REVISION ⚠2:
REVISED: LENGTH OF SUPPORT LEGS (WERE 3'-2").
INCREASED LENGTH OF INT. PIPES @ S11b & S11c.
SIZE OF S7 (WAS 24"). SIZE OF S11a (WAS 1").
PROJECTION FOR S7 (WAS 2'-6" TO T.L.)
REORIENTED S7 & S11c.
ADDED: CONN. S12; REINF. PAD & STIFFENERS @ S7.
GUIDE CLIP @ S11c.

NOZZLES

TANKS 8D-3 & 8D-4

NOZZLE	SIZE	NO. REQ.	DIM. "A" PER DWG. 15E-D-5	SERVICE	REMARKS
S1	1½"	1	0.145"	COOLING WATER INLET-INNER COIL	W/INT'L.
S2	1½"	1	0.145"	COOLING WATER OUTLET-INNER COIL	DO
S3	1½"	1	0.145"	COOLING WATER INLET-OUTER COIL	DO
S4	1½"	1	0.145"	COOLING WATER OUTLET-OUTER COIL	DO
S5	3"	1	0.216"	INLET FROM 7D-10.	
S6	3"	1	0.216"	SPARE	
S7	18" OD	1	0.312"	ACCESS OPENING	19" O.D.×5/16" ℞ STUB
S8	4"	1	0.237"	VENT TO 8C-1.	
S9	1½"	1	0.145"	RE. JRN FROM VAULT.	
S10a	½"	1	0.147"	TI & TR CONNS	W/INTERNAL
S10b	½"	1	0.147"		DO
S10c	½"	1	0.147"		DO
S11a	½"	1	0.147"	LI, PR & LAH CONNS	
S11b	½"	1	0.147"		W/INTERNAL
S11c	½"	1	0.147"		W/INTERNAL
S12	½"	1	0.147"	UTILITY AIR PURGE CONN.	
S13	1¼"	1	0.140"	COOLING WATER INLET, BOTTOM COIL	W/INTERNAL
S14	1¼"	1	0.140"	COOLING WATER OUTLET, BOTTOM COIL	W/INTERNAL

NOTE
ALL CONNECTIONS TO BE BEVELED INTERNALLY TO MATCH CONNECTING PIPE THICKNESS

No.	DATE	REVISIONS	BY	CH'K	DFTG. SUPV.	ENG'R	CHIEF ENG'R	CLIENT
⚠4	3/18/65	SEE REVISION NOTE # 4 AT LEFT	LSH	N	RDN			
⚠3	2/8/65	SEE REVISION NOTE #3 ABOVE	LSH	N	RDN			
⚠2	11/6/64	SEE REVISION NOTES ABOVE	N.	EDE	RDN			
⚠1	7/29/64	SEE REVISION NOTES ABOVE. ISSUED FOR COMPLETION	N	N	RDN			
⚠0	10-11-63	ISSUED FOR QUOTATIONS	EDE		RDN			

SCALE | DESIGNED | DRAWN EDE

BECHTEL CORPORATION
NEW YORK SAN FRANCISCO LOS ANGELES
ENGINEERING BY BECHTEL ASSOCIATES
NUCLEAR FUEL SERVICES, INC.
SPENT FUEL PROCESSING PLANT

CON-ED WASTE STORAGE TANKS
8D-3 & 8D-4

JOB No.	DRAWING No.	REV.
4413	8B-D-4	4

Appendix B

Calculation of Scaling Factors Associated with Tank 8D-4 Radionuclide Inventory

Calculation of Scaling Factors Associated with Tank 8D-4

Tank 8D-4 scaling factors were developed considering historic waste inputs to the tank and selecting the most conservative ratios of the key radioisotopes to Cs-137.

Tables A and B provide radionuclide distributions for Batch 10 and THOREX respectively. Tables C and D present the analytical data for Tank 8D-4 samples collected from the Concentrator Feed Makeup Tank (CFMT) during Tank 8D-4 flushing operations which were used to calculate scaling ratios to Cs-137 provided in Table E. Samples were collected during two Tank 8D-4 flushing evolutions. Whenever raw data values were reported as combined isotopic measurements (Cm-243/244, Pu-239/240, U-233/234, U-235/236), the individual isotopic values were obtained by using the fractional activities given in the July 29, 2002 URS memorandum, J. Wolniewicz to L. Michalczak, "Nuclide Ratios for Use in the Facility Characterization Project." No decay or ingrowth adjustment of the data presented in Table D was needed because the samples were collected and the dose rates were taken within one year of each other. (Samples were collected in January 2002 and dose rates were measured in July 2002).

The pre- and post-flush #1 CFMT radionuclide inventory is calculated from the analytical data given in Table D and the CFMT liquid volumes and specific gravity given in Table C. The resultant pre- and post-8D-4 flush CFMT inventories and 8D-4 activity transferred (difference of pre- and post-flush inventories) is shown in Table E. The radionuclide-to-Cs-137 ratios for 8D-4 activity transferred were constructed and are also presented in Table E. Radionuclides C-14 and I-129 were not analyzed for CFMT samples. The Batch 10 Vitrification Run was the first HLW treatment batch in 1996 and would be conservatively representative of waste streams handled by Tank 8D-4. Ratios for the unmeasured radionuclides C-14 and I-129 were calculated using Batch 10 scaling factors decayed to the July 2002 survey data and are shown below.

Radionuclide	Scaling Radionuclide	Batch 10 Ratio	Batch 10 Ratio Decayed from May 1997 to July 2002
C-14	Tc-99	5.80e-03	5.80e-03
I-129	Tc-99	4.62e-06	4.62e-06

Table A

Batch 10 Radionuclide Distribution*

Radionuclide	μCi/g (PNNL)
C-14	4.90e-04
Tc-99	8.45e-02
I-129	3.90e-07
U-233	3.60e-03
U-234	1.30e-03
U-235	3.80e-05
Np-237	2.00e-02
U-238	3.40e-04
Pu-238	3.96e+00
Pu-239	1.09e+00
Pu-240	7.70e-01
Pu-241	3.43e+01
Am-241	3.21e+01
Cm-243	2.58e-01
Cm-244	6.72e+00
Cs-137	2.85e+03
Sr-90	2.75e+03

* From Pacific Northwest National Laboratory (PNNL) Report WVSP 00-28, "WVDP Radioactive Waste Characterization Letter Report - Part 1: Physical, Chemical, and Radiochemical Analytical Data," dated March 2000.

Table B

THOREX Radionuclide Distribution

Long-Lived Isotopes	Curies*
C-14	1.30e-01
Tc-99	1.04e+02
I-129	1.80e-01
U-232	2.74e+00
U-233	2.09e+00
U-234	2.17e-01
U-235	5.17e-03
Np-237	3.02e-01
U-238	7.11e-03
Pu-238	4.80e+02
Pu-239	1.54e+01
Pu-240	8.09e+00
Pu-241	8.50e+02
Am-241	2.41e+02
Cm-243	2.34e-01
Cm-244	1.37e+01
Cs-137	4.75e+05
Sr-90	4.54e+05

* From WVNSCO Letter WD:86:0804, L. E. Rykken to W. W. Bixby, "Reference Radionuclide Content of High-Level Waste," dated November 10, 1986.

Table C

Tank 8D-4 Pre- / Post-Flushing Sampling Data

Sample Description	Collection Point	Sample ID # VAST	Date Collected	CFMT Volume (liters)	CFMT Specific Gravity
Pre 8D-4 Flush #1	CFMT	02-0009	1/2/02	8946.8	1.086
Post 8D-4 Flush #1	CFMT	02-0127	1/25/02	7601.7	1.211
Pre 8D-4 Flush #2	CFMT	02-0411	3/4/02	19781.7	1.107
Post 8D-4 Flush #2	CFMT	02-0428	3/20/02	10476.2	1.211

Table D

Tank 8D-4 Flush # 1 Averaged (Geometric Mean) Sample Results*

Radionuclide	Pre-Flush #1 VAST 02-0009 (μCi/g)	Post-Flush #1 VAST 02-0127 (μCi/g)
Tc-99	1.87e-01	2.04e-01
I-129	4.23e-04	3.62e-04
U-232	5.05e-04	1.24e-03
U-233/234**	2.46e-04	5.17e-04
U-233	2.46e-04	3.50e-04
U-234	7.94e-05	1.67e-01
U-235/236**	1.53e-05	2.27e-05
U-235	3.81e-06	5.68e-06
Np-237	3.67e-04	7.72e-04
U-238	1.19e-05	1.75e-05
Pu-238	6.40e-02	2.23e-01
Pu-239/240**	2.79e-02	6.66e-02
Pu-239	1.58e-02	3.77e-02
Pu-240	1.24e-02	2.88e-02
Pu-241	3.68e-01	8.94e-01
Am-241	2.38e-01	9.82e-01
Cm-243/244**	3.94e-02	1.75e-01
Cm-243	1.45e-03	6.47e-03
Cm-244	3.79e-02	1.69e-01
Cs-137	2.45e+03	4.05e+03
Sr-90	4.70e+01	1.07e+02

* Data obtained from VAST Reports 02-0009, 02-0127, 02-0411, and 02-0248.

** U-233/234, U-235/236, Pu-239/240, and Cm-243/244: Analysis is performed via alpha spectroscopy in which separation between the isotopic peaks is not possible. Reported above are the values for the combined isotopes (as reported in the original laboratory data report) and the derived values for each of the isotopes based on URS Memorandum, J. Wolniewicz to L. Michalczak, "Nuclide Ratios for Use in the Facility Characterization Project," dated July 29, 2002.

Table E

Pre- and Post-Tank 8D-4 Flush # 1 CFMT Inventory

Radionuclide	Pre Flush #1 CFMT Inventory (Ci)	Post Flush #1 CFMT Inventory (Ci)	Curies Transferred from Tank 8D-4	8D-4 Flush Profile Scaling Factor to Cs-137
C-14*	-------	-------	-------	2.33e-07
Tc-99	1.33e+00	1.88e+00	5.42e-01	4.02e-05
I-129**	4.11e-03	3.33e-03	< 0*	1.86e-10
U-232	4.90e-04	1.14e-02	6.47e-03	4.79e-07
U-233	1.59e-03	3.22e-03	1.63e-03	1.21e-07
U-234	7.72e-04	1.54e+00	1.54e+00	1.14e-04
U-235	3.71e-05	5.23e-05	1.52e-05	1.13e-09
Np-237	3.56e-03	7.11e-03	3.54e-03	2.63e-07
U-238	1.16e-04	1.61e-04	4.54e-05	3.37e-09
Pu-238	6.22e-01	2.06e+00	1.43e+00	1.06e-04
Pu-239	1.54e-01	3.47e-01	1.94e-01	1.44e-05
Pu-240	1.17e-01	2.65e-01	1.48e-01	1.10e-05
Pu-241	3.57e+00	8.23e+00	4.66e+00	3.45e-04
Am-241	2.31e+00	9.04e+00	6.74e+00	4.99e-04
Cm-243/244	3.82e-01	1.61e+00	1.19e+00	9.13e-05
Cm-243	1.41e-02	5.95e-02	4.54e-02	3.37e-06
Cm-244	3.68e-01	1.55e+00	1.19e+00	8.79e-05
Cs-137	2.38e+04	3.73e+04	1.35e+04	1.00e+00
Sr-90	4.57e+02	9.88e+02	5.31e+02	3.94e-02

Using ratios: * C-14/Tc-99 = 5.80e-03
** I-129/Tc-99 = 4.62e-06

Table F

Sample Results Averaged from Tank 8D-4 Flush # 2*

Radionuclide	Pre-Flush #2 (VAST 02-0411) μCi/g	Post-Flush #2 (VAST 02-0428) μCi/g
Gross Alpha	8.00e-01	1.79e+00
Gross Beta	2.56e+03	4.69e+03
Sr-90	4.03e+01	9.59e+01
Am-241	9.79e-01	9.60e-01
Cs-137	2.18e+03	3.85e+03

* Data obtained from VAST Reports 02-0009, 02-0127, 02-0411, and 02-0248.

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Peer Reviewed By: ______ 2/27/04
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Table G

CFMT Radionuclide Inventory

Curies transferred from CFMT to 8D-4

CFMT Volume as of 1/29/04=6,109 Liters
CFMT Volume as of 1/30/04=585 Liters
CFMT Vol. transferred= 5,524 Liters

8D-4 volume as of 4/18/03=2253 gallons

As of 9/30/04

Project Isotope	VAST 03-1155 Sample Date: 7/7/03 (μCi/ml)	VAST 03-1155 Sample Date: 7/7/03 (μCi/ml)	VAST 03-1155 Sample Date: 7/7/03 (μCi/ml)	Geometric Mean (μCi/ml)	As of 9/30/2004	Total Curies in CFMT Pretransfer	Total Curies in CFMT After Transfer	Curies Transferred to Tank 8D-4 As of 9/30/04
C-14								2.27e-03
Tc-99	2.89e-01	2.80e-01	2.94e-01	2.88e-01	2.88e-01	1.76e+00	1.68e-01	1.59e+00
I-129								1.82e-06
U-232	3.13e-03	2.07e-03	6.79e-03	3.53e-03	3.49e-03	2.13e-02	2.04e-03	1.93e-02
U-233/234	1.91e-03	1.26e-03	4.14e-03	2.15e-03		0.00e+00	0.00e+00	0.00e+00
U-233	1.29e-03	8.53e-04	2.80e-03	1.46e-03	1.46e-03	8.92e-03	8.54e-04	8.07e-03
U-234	6.17e-04	4.07e-04	1.34e-03	6.95e-04	6.95e-04	4.25e-03	4.07e-04	3.84e-03
U-235/236	1.44e-04	2.67e-04	3.55e-04	2.39e-04		0.00e+00	0.00e+00	0.00e+00
U-235	3.60e-05	6.68e-05	8.88e-05	5.97e-05	5.97e-05	3.65e-04	3.49e-05	3.30e-04
Np-237	7.08e-04	5.77e-04	4.62e-04	5.74e-04	5.74e-04	3.51e-03	3.36e-04	3.17e-03
U-238	1.41e-04	9.33e-05	3.06e-04	1.59e-04	1.59e-04	9.71e-04	9.30e-05	8.78e-04
Pu-238	6.03e-02	5.84e-02	6.82e-02	6.22e-02	6.16e-02	3.76e-01	3.60e-02	3.40e-01
Pu-239/240	2.94e-02	2.95e-02	3.60e-02	3.15e-02				
Pu-239	1.67e-02	1.67e-02	2.04e-02	1.79e-02	1.79e-02	1.09e-01	1.05e-02	9.89e-02
Pu-240	1.27e-02	1.28e-02	1.56e-02	1.36e-02	1.36e-02	8.31e-02	7.96e-03	7.51e-02
Pu-241	4.17e-01	3.17e-01	4.65e-01	3.95e-01	3.72e-01	2.27e+00	2.18e-01	2.05e+00
Am-241	2.83e-01	2.75e-01	3.02e-01	2.86e-01	2.86e-01	1.75e+00	1.67e-01	1.58e+00
Cm-243/244	4.34e-02	3.78e-02	4.47e-02	4.19e-02				
Cm-243	1.60e-03	1.39e-03	1.65e-03	1.54e-03	1.49e-03	9.10e-03	8.72e-04	8.23e-03
Cm-244	4.18e-02	3.64e-02	4.30e-02	4.03e-02	3.84e-02	2.35e-01	2.25e-02	2.12e-01
Cs-137	1.69e+03	1.66e+03	1.77e+03	1.71e+03	1.66e+03	1.01e+04	9.71e+02	9.17e+03
Sr-90	2.60e+00	2.59e+00	2.70e+00	2.63e+00	2.55e+00	1.56e+01	1.49e+00	1.41e+01
Total							9.73E+02	9.19E+03

Note: C-14 and I-129 are estimated based on selected scaling factors for Tank 8D-4.

Table H

Tank 8D-4 Radionuclide Inventory (As of September 30, 2004)

Project Isotope(1)	Tank 8D-4 Curies Pre-Transfer	Curies Transferred From CFMT to Tank 8D-4	Total Tank 8D-4 Curie Content(2)	Total Curies Post Tank 8D-4 Drain(3)	Total Curies After First Tank 8D-4 Rinse and Drain(4)
C-14	1.53e-03	2.27e-03	3.81e-03	1.70e-03	2.24e-04
Tc-99	2.65e-01	1.59e+00	1.86e+00	8.29e-01	1.09e-01
I-129	1.22e-06	1.82e-06	3.04e-06	1.36e-06	1.79e-07
U-232	2.75e-03	1.93e-02	2.20e-02	9.84e-03	1.30e-03
U-233	9.21e-03	8.07e-03	1.73e-02	7.72e-03	1.02e-03
U-234	7.48e-01	3.84e-03	7.52e-01	3.36e-01	4.43e-02
U-235	9.76e-05	3.30e-04	4.27e-04	1.91e-04	2.52e-05
Np-237	5.13e-02	3.17e-03	5.45e-02	2.43e-02	3.21e-03
U-238	8.71e-04	8.78e-04	1.75e-03	7.82e-04	1.03e-04
Pu-238	9.58e+00	3.40e-01	9.92e+00	4.43e+00	5.84e-01
Pu-239	2.79e+00	9.89e-02	2.89e+00	1.29e+00	1.70e-01
Pu-240	1.98e+00	7.51e-02	2.06e+00	9.20e-01	1.21e-01
Pu-241	6.16e+01	2.05e+00	6.36e+01	2.84e+01	3.74e+00
Am-241	8.22e+01	1.58e+00	8.38e+01	3.74e+01	4.93e+00
Cm-243	5.54e-01	8.23e-03	5.62e-01	2.51e-01	3.31e-02
Cm-244	1.30e+01	2.12e-01	1.32e+01	5.89e+00	7.77e-01
Cs-137	6.18e+03	9.17e+03	1.53e+04	6.86e+03	9.04e+02
Sr-90	5.90e+03	1.41e+01	5.91e+03	2.64e+03	3.48e+02

Notes:

1. C-14 and I-129 are estimates based on Tank 8D-4 scaling factors.
2. Tank 8D-4 volume after receiving CFMT transfer on 1/30/04 was 4,029 gallons (15,250 liters).
3. Tank 8D-4 will be drained and the remaining heel will be 1,800 gallons (6,813 liters).
4. Tank 8D-4 will be filled to full capacity of 13,659 gallons (51,700 liters) with water and drained to a remaining heel volume of 1,800 gallons (6,813 liters).

Appendix C

MicroShield™ Modeling Calculations

Component or area: Tank 8D-4

Model geometry used: Cylinder Volume - Side Shields & Cylinder Surface - External Dose Point

Given/Facts:

1. Dose rates were measured outside of tank 8D-4 in three locations. The tank had a liquid heel level of 33.4 inches and two helical cooling coils along its sidewall.

2. Liquid in the tank had a measured density of 1.01 gm/cm^3

Assumptions:

1. Cesium 137 is the radioisotope generating the dose field outside the tank. This isotope is uniformly distributed within the liquid contents in the tank and all dose is attributed to the tank contents.

2. Wall thickness of the tank was assumed to be 0.31 inches of iron.

3. Cesium 137 is uniformly distributed on the internal surfaces of the tank above the liquid.

4. Two models were run, one for the lower part with liquid, and another for the upper part. It's assumed dose rate measured near the upper liquid level is due to both the tank liquid contents contribution and surface contamination contribution. Surface contamination, the upper part, contributes 11 R/hr.

5. Measured dose rate 18 inches from tank bottom is not influenced by upper surface contamination or any stratification of solid contents at the tank bottom.

Calculation:
Input into the model

Detector position: 19.25 inches from the tank wall along a vertical path 0, 18, and 30 inches from the bottom of the tank.

Lower Section
Source dimensions: Liquid contents of tank with a 71.7 inch radius 33.4 inches deep
Reading modeled: 17.3 R/hr
Source material:
Upper Section
Source dimensions: 155.6" height (tangent to distance from DWG 900S-8611) and 71.7 inch radius
Reading modeled: 25.7 R/hr - 14.3 R/hr = 11.4 R/hr
Source material: N/A
Drawings: 900S-8611 and Bechtel Drawing 8B-D-8

Work Documents/Surveys: Radiation & Contamination Survey Reports 123029 & 123067

Model prepared by: Robert Brooks, Robert Brooks, 2/12/04
Signature/Print name/Date

Model peer reviewed by: Ed Lachapelle E. Lachapelle 2/12/04
Signature/Print name/Date

Tank 8D-4
Liquid Level 33.4 inches from the bottom

Tank Level	Measured Dose rates R/hr	Calculated Dose rates R/hr	Calculated Dose rates with shielding R/hr
30" above bottom	25.7	14.3	13.9
18" above bottom	17.3	17.3	17.3
0" above bottom	14.5	12.7	12.3
Curies (liquid)		3217	4876
Curies (Upper Tank Surface)		1407	1407
Total Curies(Cs-137)		**4624**	**6283**

Calculation of Curies in the Heel of Tank 8D-4

To determine the residual curies within tank 8D-4, a set of three dose rate measurements were taken outside the tank. Calculations were made to model the curie content of liquid within the tank and contamination on its inner surface that would reproduce the measured dose rates outside the tank walls.

The initial calculated dose rates are recorded in the table above in column #2(Calculated Dose Rates). Liquid level inside the tank was 33.4 inches from the bottom. With three points where dose rates were measured, the curies of radioactive material, Cs-137, needed to reproduce the middle value was calculated. The middle dose rate would be least influenced by other sources at the upper section and bottom of the tank or stratification of its contents. Dimensions of the tank and distances between the tank and positions where measurements were collected were taken off supplied drawings. Density of the contaminated tank liquid was assumed to be typical of waste liquid held in this tank of 1.01 gm/cm^3. There was no consideration given to other material such as cooling coils which are inside the tank.

As dose rates are measured near the top of the liquid level, they begin to increase significantly from the calculated value indicating that an additional source is present. From modeling, it was determined that the source contributed 11.4 R/hr of the measurement taken at the top of the tank. The only source that can contribute dose of this degree is contamination in the upper section of the tank above the liquid. Assuming a uniform distribution of contamination on the inner surface of the tank above the liquid level, the number of curies from surface contamination that would result in 11.4 R/hr at the upper dose measurement point was calculated. In addition to shielding by the tank wall, the calculation adds a layer of shielding due to the cooling coils. The corresponding wall thickness cooling coils would introduce to the tank walls was included in the calculation. Curies by way of the tank surface contamination was 1407.

The last column gives the resultant dose rates and curies from calculations that included a shielding corresponding to the calculated thickness cooling coils would introduce to the contaminated liquid. Dose rates are calculated for the curie contribution of the contaminated liquid inside the tank to match the measured dose rate at 18 inches from the bottom of the tank (see column 3 Calculated Dose Rates with Shielding).

Total calculated curies in 8D-4 from Cs-137 to match the measured dose rates is a sum of curies in the contaminated liquid and the surface contamination. The above table gives values without consideration of the cooling coils in the liquid and with the cooling coils incorporated as shielding
.

123067

Radiation and Contamination Survey Report

Survey Number

West Valley Nuclear Services Co

Location WTF GEN
Work Area 8D-4 VAULT

Purpose Of Survey DOSEB RATE READINGS IN VAULT

Additional Information Attached ☐ YES ☑ NO ☐ ON BACK

Instruments Used

	TYPE	SERIAL #	EFF
☐ SCINTILLATION			
☐ GM			
☐ IONIZATION			
☐ PROPORTIONAL			α
			β
☑ Data Logger 2350-1		126208	

AREA/MATERIALS SURVEYED	SMEARABLE NET (DPM/100 cm²) COUNT TIME ___ MIN		DIRECT CHECK NET CPM		RADIATION LEVEL			
	ALPHA	BETA	ALPHA	BETA	READING	DISTANCE		
18" from Tank bottom					17.3R/hr	18" - Tank	bottom	
Tank bottom					14.5R/hr	Tank bottom		

CONCLUSIONS - AREA/MATERIALS ☐ RELEASABLE ☐ NON-RELEASABLE ☑ INFORMATION ONLY

COMMENTS (IF ANY):

RECOMMENDATIONS: ☑ NO FURTHER ACTION REQUIRED ☐ FURTHER ACTION REQUIRED

IF FURTHER ACTION REQUIRED, DESCRIBE:

Technician Name	BENZ, THOMAS A	**Date:**	06 Jan 2004
Signature:	Tom Benz	**Time:**	1330
Reviewer Name (Print):	Richard Black	**Date:**	1/8/04
Signature:	Richard Black	**Time:**	1339 hrs.

123029

Radiation and Contamination Survey Report

Survey Number

West Valley Nuclear Services Co.

Location WTF GEN
Work Area 8D4 VAULT

Purpose Of Survey DOSE RATE AT 8D4 VAULT

Additional Information Attached ☐ YES ☒ NO ☐ ON BACK

Instruments Used

	TYPE	SERIAL #	EFF
☐ SCINTILLATION			
☐ GM			
☐ IONIZATION			
☐ PROPORTIONAL			
☒	2350-1	#126208	

AREA/MATERIALS SURVEYED	SMEARABLE NET (DPM/100 cm²) COUNT TIME ___ MIN		DIRECT CHECK NET CPM		RADIATION LEVEL			
	ALPHA	BETA	ALPHA	BETA	READING	DISTANCE	Cor. Factor	Cor. Reading
Dose Rate @ Vault					25.7 R/hr.			
≈30 inches from bottom. 1/5/04								

CONCLUSIONS - AREA/MATERIALS ☐ RELEASABLE ☐ NON-RELEASABLE ☒ INFORMATION ONLY
COMMENTS (IF ANY):

RECOMMENDATIONS: ☒ NO FURTHER ACTION REQUIRED ☐ FURTHER ACTION REQUIRED
IF FURTHER ACTION REQUIRED, DESCRIBE:

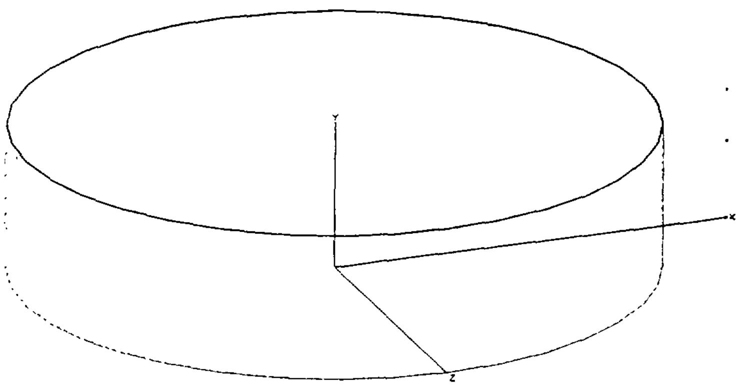
Technician Name	BAKER, HOLLY A	Date:	31 Dec 2003
Signature:	Holly Baker	Time:	1415
Reviewer Name (Print):	Richard Black	Date:	1/5/04
Signature:	Richard Black	Time:	0846 hrs

MicroShield v6.02 (6.02-0000)
Grove Engineering

Page : 1
DOS File : 8D-4tank2.ms6
Run Date: January 21, 2004
Run Time: 11:18:54 AM
Duration : 00:00:02

File Ref:
Date: 2/12/04
By: R. Smith
Checked:

Case Title: 8D-4, 33.4 in level
Description: Dose Determination at 0", 18", & 30"
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions

Height	84.836 cm	2 ft 9.4 in
Radius	182.118 cm	5 ft 11.7 in

Dose Points

	X	Y	Z
# 1	231.8004 cm	76.2 cm	0 cm
	7 ft 7.3 in	2 ft 6.0 in	0.0 in
# 2	231.8004 cm	45.72 cm	0 cm
	7 ft 7.3 in	1 ft 6.0 in	0.0 in
# 3	231.8004 cm	0 cm	0 cm
	7 ft 7.3 in	0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	5.39e+05 in^3	Water	1.01
Shield 1	.31 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.5701e+003	5.8094e+013	1.7762e+002	6.5719e+006
Cs-137	1.6597e+003	6.1409e+013	1.8776e+002	6.9470e+006

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (91.26,30,0) in

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	6.031e+11	1.916e-162	4.958e-23	1.313e-162	3.398e-23
0.0318	1.203e+12	3.211e-17	3.555e-17	2.675e-19	2.961e-19
0.0322	2.219e+12	2.668e-16	2.965e-16	2.147e-18	2.386e-18
0.0364	8.075e+11	4.415e-11	5.068e-11	2.508e-13	2.879e-13
0.6616	5.227e+13	2.769e+06	7.382e+06	5.368e+03	1.431e+04
TOTALS:	5.711e+13	2.769e+06	7.382e+06	5.368e+03	1.431e+04

Results - Dose Point # 2 - (91.26,18,0) in

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	6.031e+11	1.920e-162	5.257e-23	1.316e-162	3.603e-23
0.0318	1.203e+12	3.765e-17	4.168e-17	3.136e-19	3.472e-19

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0322	2.219e+12	3.143e-16	3.493e-16	2.530e-18	2.811e-18
0.0364	8.075e+11	5.462e-11	6.272e-11	3.104e-13	3.563e-13
0.6616	5.227e+13	3.462e+06	8.939e+06	6.711e+03	1.733e+04
TOTALS:	5.711e+13	3.462e+06	8.939e+06	6.711e+03	1.733e+04

Results - Dose Point # 3 - (91.26,0,0) in

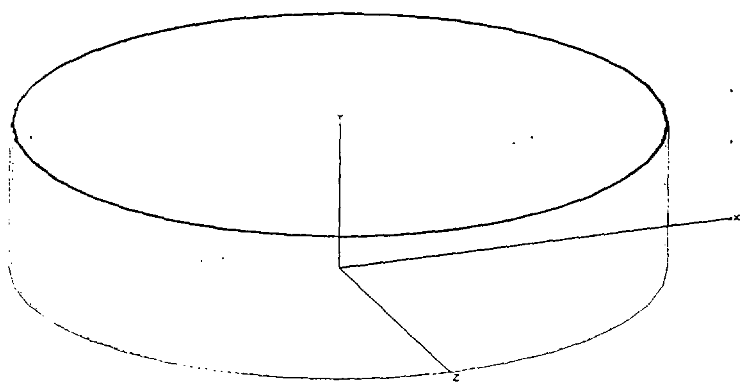
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	6.031e+11	9.590e-163	4.801e-23	6.573e-163	3.291e-23
0.0318	1.203e+12	1.883e-17	2.084e-17	1.568e-19	1.736e-19
0.0322	2.219e+12	1.572e-16	1.746e-16	1.265e-18	1.406e-18
0.0364	8.075e+11	2.732e-11	3.136e-11	1.552e-13	1.782e-13
0.6616	5.227e+13	2.424e+06	6.603e+06	4.700e+03	1.280e+04
TOTALS:	5.711e+13	2.424e+06	6.603e+06	4.700e+03	1.280e+04

MicroShield v6.02 (6.02-0000)
Grove Engineering

Page : 1
DOS File : 8D-4tank3.ms6
Run Date: January 21, 2004
Run Time: 11:11:55 AM
Duration : 00:00:02

File Ref: ________
Date: 2/12/04
By: R. Brooks
Checked: ________

Case Title: 8D-4, 33.4 in level
Description: Dose Determination at 0", 18", & 30"
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions

Height	84.836 cm	2 ft 9.4 in
Radius	182.118 cm	5 ft 11.7 in

Dose Points

	X	Y	Z
# 1	232.6386 cm	76.2 cm	0 cm
	7 ft 7.6 in	2 ft 6.0 in	0.0 in
# 2	232.6386 cm	45.72 cm	0 cm
	7 ft 7.6 in	1 ft 6.0 in	0.0 in
# 3	232.6386 cm	0 cm	0 cm
	7 ft 7.6 in	0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	5.39e+05 in³	Water	1.01
Shield 1	.31 in	Iron	7.86
Shield 2	.33 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.3706e+003	8.7712e+013	2.6818e+002	9.9226e+006
Cs-137	2.5060e+003	9.2722e+013	2.8349e+002	1.0489e+007

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (91.59,30,0) in

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	9.105e+11	0.000e+00	7.409e-23	0.000e+00	5.079e-23
0.0318	1.816e+12	2.168e-37	1.150e-21	1.806e-39	9.577e-24
0.0322	3.350e+12	8.489e-36	2.155e-21	6.832e-38	1.735e-23
0.0364	1.219e+12	9.041e-25	9.448e-22	5.137e-27	5.368e-24
0.6616	7.892e+13	2.157e+06	7.199e+06	4.181e+03	1.396e+04
TOTALS:	8.622e+13	2.157e+06	7.199e+06	4.181e+03	1.396e+04

Results - Dose Point # 2 - (91.59,18,0) in

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	9.105e+11	0.000e+00	7.849e-23	0.000e+00	5.380e-23

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	1.816e+12	2.351e-37	1.218e-21	1.958e-39	1.015e-23
0.0322	3.350e+12	9.237e-36	2.283e-21	7.434e-38	1.838e-23
0.0364	1.219e+12	1.025e-24	1.001e-21	5.823e-27	5.686e-24
0.6616	7.892e+13	2.775e+06	8.939e+06	5.379e+03	1.733e+04
TOTALS:	8.622e+13	2.775e+06	8.939e+06	5.379e+03	1.733e+04

Results - Dose Point # 3 - (91.59,0,0) in

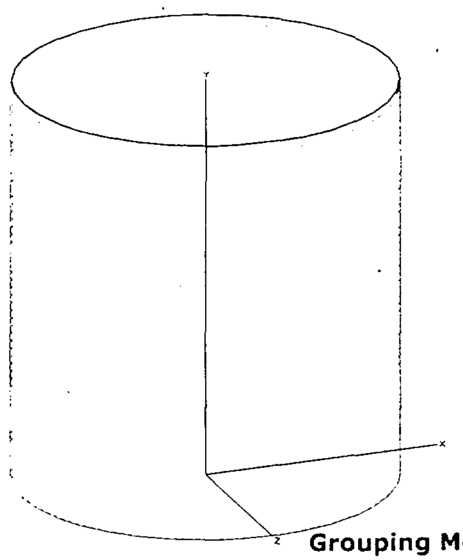
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	9.105e+11	0.000e+00	7.178e-23	0.000e+00	4.920e-23
0.0318	1.816e+12	1.176e-37	1.114e-21	9.792e-40	9.279e-24
0.0322	3.350e+12	4.619e-36	2.088e-21	3.717e-38	1.681e-23
0.0364	1.219e+12	5.125e-25	9.153e-22	2.912e-27	5.200e-24
0.6616	7.892e+13	1.851e+06	6.334e+06	3.589e+03	1.228e+04
TOTALS:	8.622e+13	1.851e+06	6.334e+06	3.589e+03	1.228e+04

MicroShield v6.02 (6.02-0000)
Grove Engineering

Page : 1
DOS File : 8D-4surfacecont.ms6
Run Date: January 21, 2004
Run Time: 11:34:26 AM
Duration : 00:00:00

File Ref: ________
Date: ________
By: ________
Checked: ________

Case Title: Case 1
Description: Case 1
Geometry: 10 - Cylinder Surface - External Dose Point



Source Dimensions

Height	387.604 cm	12 ft 8.6 in
Radius	182.118 cm	5 ft 11.7 in

Dose Points

	X	Y	Z
# 1	231.8004 cm	396.24 cm	0 cm
	7 ft 7.3 in	13 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Cyl. Radius	182.118 in	Air	0.00122
Shield 1	.31 in	Iron	7.86
Shield 2	.33 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122
Immersion		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm²	Bq/cm²
Ba-137m	6.8389e+002	2.5304e+013	1.5419e+003	5.7051e+007
Cs-137	7.2293e+002	2.6748e+013	1.6300e+003	6.0308e+007

Buildup
The material reference is : Shield 1

Integration Parameters

Y Direction (axial)	20
Circumferential	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	2.627e+11	1.531e-316	1.253e-23	1.050e-316	8.586e-24
0.0318	5.239e+11	4.618e-36	1.944e-22	3.847e-38	1.619e-24
0.0322	9.665e+11	1.566e-34	3.644e-22	1.260e-36	2.933e-24
0.0364	3.517e+11	4.973e-24	1.621e-22	2.826e-26	9.210e-25
0.6616	2.277e+13	2.337e+06	5.880e+06	4.530e+03	1.140e+04
TOTALS:	2.487e+13	2.337e+06	5.880e+06	4.530e+03	1.140e+04

Calculated Weight of Cooling coils inside of 8D-4

Two cooling coils, diameter of 10 ft and diameter of 11 ft
Coil material 1.5 inch sch 80S pipe
Weight of 1.5 inch sch 80S pipe = 3.63 lbs/ft
Length of 10 ft diameter pipe = 406.87 ft
Length of 11 ft diameter pipe = 411.07 ft
Density of pipe = 480 lbs/ft^3 = 7.7 gm/cm^3

Weight of 10 ft diameter pipe = (406.87 ft)(3.63 lbs/ft) = 1,476.94 lbs
Weight of 11 ft diameter pipe = (411.07 ft)(3.63 lbs/ft) = 1,492.18 lbs
Total weight of cooling coils = 1,476.94 + 1,492.18 = 2,969.12 lbs

Calculation of the square footage of tank sidewall added for coils

Inside Diameter of the tank = 11.95 ft
height of coils = 5.98 ft
Square footage of tank sidewall = π(Diameter)(height)
= (3.14)(11.95 ft)(5.98 ft) = **224.50 ft^2**

Thickness of Wall if Cooling coils were part of tank sidewall

Volume of metal used for coils

Volume = Mass/Density
Volume = 2,969.12 lbs ÷ 480 lbs/ft^3
Volume = 6.19 ft^3

Added thickness of tank wall because of coils

Thickness = Volume/Square footage
Thickness = 6.19 ft^3 ÷ 224.50 ft^2
Thickness = 0.0276 ft = 0.33 inches

Appendix D

Technical Review and Approval Panel Consensus Statement

FACILITY CHARACTERIZATION PROJECT

Technical Review and Approval Panel
Consensus Statement

Unit Name: Waste Storage Tank 8D-4

Summary of Technical Approach That Was Utilized:

The Tank 8D-4 radionuclide inventory was generated using process knowledge, existing verifiable data, newly collected dose rate surveys, and Tank 8D-4 flushing samples. A forecasted final Tank 8D-4 radionuclide inventory was calculated based on the following technical approach.

Cesium-137 was quantified using general area dose rate surveys and the MicroShield™ computer modeling software assuming all of the gamma dose was attributed to Cs-137. The December 2003 and January 2004 dose rate survey data were used to recalculate Tank 8D-4 inventory. Scaling factors were developed using the most conservative values of historic and newly collected samples that represent the contents of the tank, including Batch 10 vitrification data, THOREX waste, SBS liquid, and the samples collected during Tank 8D-4 flushing. Since THOREX has been flushed out of Tank 8D-4 as shown by Dilution Model, scaling factors from THOREX were not used. The scaling factors from Batch 10 and Tank 8D-4 flush profile were compared and more conservative number was selected as scaling factor. The resulting conservative radionuclide ratios for the specific long-lived radionuclides are multiplied by the scaling radionuclide, Cs-137, to generate the total inventory. Calculated radionuclides were decayed to September 2004. An increase in the radionuclide inventory of Tank 8D-4 due to the January 30, 2004 liquid transfer from the CFMT was estimated and added to the projected September 2004 inventory.

It is assumed that the Tank 8D-4 contents will be drained and rinsed at least one time by filling Tank 8D-4 with water and drained again. Approximately 1,800 gallons of diluted heel will remain in Tank 8D-4. Estimated radionuclide inventory for each case is calculated based on these projected activities. Should this assumption change, the radionuclide inventory of Tank 8D-4 must be revisited.

Curie Estimate

The following table provides the curie estimates for Tank 8D-4 after the January 30, 2004 CFMT transfer and for the following potential future (post-September 30, 2004) scenarios: after draining the tank down to its 1,800 gallon heel, then after rinsing the tank with approximately 12,000 gallons of water, then after draining it again down to a diluted heel of 1,800 gallons.

Conservative Curie Estimates for Tank 8D-4[(2)]*

Project Isotope	Tank 8D-4 Inventory After CFMT Transfer	Projected Tank 8D-4 Inventory After Drain[(1)] (1,800 Gallons of Heel)	Project Tank 8D-4 Inventory After Rinse and Drain[(1)] (1,800 Gallons of Heel)
C-14	3.81e-03	1.70e-03	2.24e-04
Tc-99	1.86e+00	8.29e-01	1.09e-01
I-129	3.04e-06	1.36e-06	1.79e-07
U-232	2.20e-02	9.84e-03	1.30e-03
U-233	1.73e-02	7.72e-03	1.02e-03
U-234	7.52e-01	3.36e-01	4.43e-02
U-235	4.27e-04	1.91e-04	2.52e-05
Np-237	5.45e-02	2.43e-02	3.21e-03
U-238	1.75e-03	7.82e-04	1.03e-04
Pu-238	9.92e+00	4.43e+00	5.84e-01
Pu-239	2.89e+00	1.29e+00	1.70e-01
Pu-240	2.06e+00	9.20e-01	1.21e-01
Pu-241	6.36e+01	2.84e+01	3.74e+00
Am-241	8.38e+01	3.74e+01	4.93e+00
Cm-243	5.62e-01	2.51e-01	3.31e-02
Cm-244	1.32e+01	5.89e+00	7.77e-01
Cs-137**	1.53e+04	6.86e+03	9.04e+02
Sr-90**	5.91e+03	2.64e+03	3.48e+02

(1) These activities have the potential to occur after September 30, 2004.

(2) Estimates have been aged to a reference date of September 30, 2004.

* The method of choosing the project isotopes is outlined in WVDP-403, "Characterization Management Plan for the Facility Characterization Project" (CMP).

** Cs-137 and Sr-90 are not critical radionuclides for the outcome of the performance assessment but are report for completeness per WVDP-403.

Using best engineering judgement and available information, the following listed Technical Review and Approval Panel Members have reviewed the technical approach and resultant conservative curie estimate for the stated area/cell and have reached consensus that the approach and resultant estimate are technically sound for purposes of this project's scope as identified in the Characterization Management Plan for the Facility Characterization Project (WVDP-403).

Project Manager:	L. E. Rowell	3/12/04 (Signature/Date)
Project Lead:	V. K. Sharma	2/25/04 (Signature/Date)
Radiation Engineering and Dosimetry:	R. B. Brooks	2/27/04 (Signature/Date)
Radiation Protection:	R. L. Hazard	3/1/04 (Signature/Date)
Decommissioning Planning:	D. R. Westcott	DR Westcott 2/27/04 (Signature/Date)
Analytical and Process Chemistry	C. J. Maddigan	3/2/04 (Signature/Date)

WVNSCO RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue Facility Characterization Project and Regulatory & Compliance Programs departments are affected by this document.	All	11/12/02
1	Table A - Batch 10 radionuclide distribution; Cm-243 value corrected to read 2.58e-01 rather than 6.98e+00. Appendix D - Corrected page numbering of Work Order 69053. Appendix E - MicroShield™ modeling was revised to clarify description and various cases presented in the modeling.	23 45 - 66 68 - 110	06/16/03
2	This revision incorporates changes in the Tank 8D-4 inventory based on the latest dose rate surveys collected in December 2003 and January 2004 and projects the future inventory of Tank 8D-4 after draining the tank, rinsing the tank once with water, and potentially draining the tank to the heel. Reformatted document appearance to be consistent with current inventory report format. Facility Characterization Project and Decommissioning Planning departments are affected by the changes in this document.	All	03/12/04